NAVAL WAR COLLEGE
Newport, R.I.

The widening gap of interoperability between US and coalition/allied communications systems: A challenge for the Operational Commander

by

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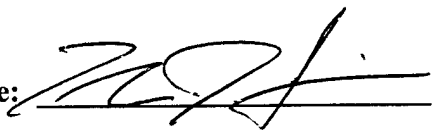
A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

Signature: 

13 June 1997

Paper directed by Captain George W. Jackson, USN
Chairman, Joint Military Operations Department

REPORT DOCUMENTATION PAGE

1. Report Security Classification: UNCLASSIFIED	
2. Security Classification Authority:	
3. Declassification/Downgrading Schedule:	
4. Distribution/Availability of Report: DISTRIBUTION STATEMENT A: APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.	
5. Name of Performing Organization: JOINT MILITARY OPERATIONS DEPARTMENT	
6. Office Symbol: C	**7. Address:** NAVAL WAR COLLEGE 686 CUSHING ROAD NEWPORT, RI 02841-1207
8. Title (Include Security Classification): The widening gap of interoperability between US and coalition/allied communications systems: A challenge for the Operational Commander. (U)	
9. Personal Authors: Major Thomas J. Hains, USAF	
10.Type of Report: FINAL	**11. Date of Report:** 7 Feb 1997
12.Page Count: 23	
13.Supplementary Notation: A paper submitted to the Faculty of the NWC in partial satisfaction of the requirements of the JMO Department. The contents of this paper reflect my own personal views and are not necessarily endorsed by the NWC or the Department of the Navy.	
14. Ten key words that relate to your paper: Communications interoperability enables the operational commander to command and control.	

15.Abstract: Communications systems are very important, but often overlooked. As communications systems become more sophisticated, the problem is exacerbated by the inability of systems to work together, especially between the US and allied or coalition nations. As a definition, interoperability is the ability of the operational commander to use communications systems to exercise command, control and direction across the range of military operations. Unfortunately the widening gap in interoperability results in the inability of the operational commander to oversee and direct the forces under his command. If the US is determined to be a team player, then we need to make every effort to ensure that we can communicate and coordinate with the other members of our team. The US is not entirely at fault in this matter. Part of the problem is the inability of our allied/coalition members to keep pace. There doesn't appear to be a current solution, but there are five possible courses of action to narrow/eliminate this gap: the US could "go it alone," provide coalition alliance members with the necessary communications systems, provide members with screened information, standardize all future coalition/allied acquisitions, or use coalition/allied forces in centralized but only low-tech situations. Unfortunately, all current efforts have their drawbacks for the benefits attained. Although there currently isn't a magic solution, now is the time to commit ourselves to the effort. Given the right framework, outlook, and commitment of resources, we can overcome it.

16.Distribution / Availability of Abstract:	**Unclassified** X	**Same As Rpt**	**DTIC Users**
17.Abstract Security Classification: UNCLASSIFIED			
18.Name of Responsible Individual: CHAIRMAN, JOINT MILITARY OPERATIONS DEPARTMENT			
19.Telephone: 841-6461		**20.Office Symbol:** C	

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Communications systems are very important, but often overlooked. As communications systems become more sophisticated, the problem is exacerbated by the inability of systems to work together, especially between the US and allied or coalition nations.

As a definition, interoperability is the ability of the operational commander to use communications systems to exercise command, control and direction across the range of military operations. Unfortunately the widening gap in interoperability results in the inability of the operational commander to oversee and direct the forces under his command. If the US is determined to be a team player, then we need to make every effort to ensure that we can communicate and coordinate with the other members of our team.

The US is not entirely at fault in this matter. Part of the problem is the inability of our allied/coalition members to keep pace.

There doesn't appear to be a current solution, but there are five possible courses of action to narrow/eliminate this gap: the US could "go it alone," provide coalition alliance members with the necessary communications systems, provide members with screened information, standardize all future coalition/allied acquisitions, or use coalition/allied forces in centralized but only low-tech situations. Unfortunately, all current efforts have their drawbacks for the benefits attained.

Although there currently isn't a magic solution, now is the time to commit ourselves to the effort. Given the right framework, outlook, and commitment of resources, we can overcome it.

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"For want of a nail, the shoe was lost; for want of a shoe the horse was lost; and for want of a horse the rider was lost, being overtaken and slain by the enemy, all for the want of care about a horseshoe nail" - *Benjamin Franklin*

Introduction

The first question that probably springs to mind is what this quote has to do with communications systems. It's really quite simple. Just like the horseshoe nail, communications systems are very important, but often overlooked. Less glamorous and lower profile than flying aircraft, leading men or assaulting beachheads, communications systems are part of the glue that holds the operational infrastructure together. A low prioritization of communications systems can be just as consequential as the overlooked horseshoe nail, and the inoperability of communications systems just as much of a reason for operational failure as the inability to launch aircraft or take a specified beach. As communications systems become more sophisticated, the problem is exacerbated by the inability of systems to work together, especially between the US and allied or coalition nations. Unfortunately, as long as the US continues to develop and implement new, sophisticated communications systems and spend as much money on them as it does, this problem continues to grow and the gap between US and coalition/allied communications systems becomes more of a challenge for the operational commander. This problem is an issue we need to address...in fact, the time is long overdue. This doesn't mean we should halt all of our technological efforts, just that our efforts may be at the expense of coalition/allied effectiveness.

Although there may be no magic solution to date, there are avenues we can explore to lessen the consequences of this inoperability. To explore the situation, we'll define and

codify our problem, examine its effects on operations, highlight how the US is exacerbating the problem, identify coalition/alliance difficulties, and examine some possible solutions to enhance interoperability.

Definitions

"Discussion without definition is useless" - Lord Grey[1]

As an acquaintance who served on the joint staff once said, "definitions are everything." He meant that they were important in establishing parameters in order to ensure that everyone used the same terms and meant the same thing. As we begin, it's important to define a couple of terms and highlight their importance to the operational commander. The first is "interoperability." Joint Pub 6-0 defines interoperability as, "the ability of systems, units or forces to provide services to and accept services from other systems, units or forces and to use the services to enable them to operate effectively together."[2] This is not to be confused with another/opposite term we'll use in emphasizing the lack of interoperability, that of "inoperability." Just for the record, Webster's defines inoperability as, "...ineffective and nonfunctioning."[3] For the purpose of this paper, our next two terms go together--they are "coalition" and "alliance." A coalition can best be defined as, "an ad hoc agreement between two or more nations for a common action."[4] Similarly an alliance is, "a confederation of nations by formal treaty...in an association to further the common interests of the members."[5] Lastly, combining Joint Pub 6-0's definition of "communications;" and "command, control, communications and computer systems," we learn that they're "a method or means of conveying information of any kind from one person or place to another...to support a commander's exercise of

command and control across the range of military operations..."[6] By intermixing all of these definitions, we can understand that communications interoperability gives the operational commander the...*ability to provide services to/from other systems in support of the command, control and direction of all military operations in order to further the common interests of associated nations.* In short, this means that communications systems have to be able to work together to effectively accomplish the objectives or intent of the operational commander and those of any involved nations.

The Problem/Effect On Operations

> *"(Although we may not have wished it) destiny has laid upon our country the responsibility of the free world's leadership"* - *Dwight D. Eisenhower*[7]

As this quote states, we may not always wish to take the lead in international and military affairs, but the rest of the world and particularly our alliance partners look to us to do so. Since the time of the Peloponnesian war, history has taught us that there is strength and success in fighting coalition/alliance warfare against an adversary. In support of this obligation and our need to maintain our worldwide vested interests, the US must always be cognizant of its place and effect on coalition/alliance partners. The problem this creates is that we can't just be concerned about our own military development, or our own technological and doctrinal growth. If we truly wish to maintain our place as leaders and rely on the input and strengths of our coalition or alliance partners, then these partners need to have the same kind of ability as we have...or at least be reasonably close. This is particularly true with respect to communications systems, since communications systems are the glue that holds the fighting coalition/alliance forces together via command and control. If these coalition/alliance communications systems are unable to mesh, the

operational commander loses his ability to oversee and direct the forces under his command. As US Army BGen Glacel wrote, "If anybody needs convincing of the urgent need for interoperability, they need only look at the situation in former Yugoslavia. The...peacekeeping operation includes personnel from 29 nations using 18 different languages with little, if any, supporting C2 systems."[8] This problem can be further elucidated by discussing its impact on the operational design areas of synchronization and sequencing.

As defined by the joint and operational arena, synchronization is the arrangement of actions and forces in order to produce the maximum effort at a decisive place and time[9], requiring explicit coordination among the various units and activities participating in the operation.[10] The inability of US communications systems to interact with the systems of involved coalition or allied forces is a crucial problem impacting the success of the operational objective. Without the ability to communicate quickly and effectively, the operational commander is unable to accomplish the necessary coordination between the various units. Although it may be possible to communicate and coordinate these forces using older, less sophisticated means, e.g., messengers or signaling flags, the size and scope of today's battlespace makes this kind of outdated communication difficult at best and impossible in most cases. Especially since the operational commander is most likely removed from the force engagement area, coordinating the efforts of land, air, space, and sea forces. The speed and specialization of forces further complicates the scenario. Precision guided munitions and calculated plan lines means that the ability to direct and control forces toward a decisive place and time, becomes more and more important in

achieving operational success. The synergistic effect of synchronization is lost without the means to command and control it.

Similar to synchronization, sequencing is also affected by this inoperability problem. Sequencing is the arrangement of events that will most likely accomplish the assigned tactical or operational objective.[11] Communications systems give the operational commander the means to coordinate and arrange these events in order to ensure that all US and allied/coalition forces are where they should be when they should be in order to meet the operational objective. The operational commander also uses communications systems to monitor and direct the tactical efforts of his subordinate commanders. An article in the Marine Corps Gazette discussed this need, "...our ability to execute mission tactics using decentralized control is tied directly to our ability to communicate..."[12] The inoperability that currently exists between US and coalition/allied communications systems, makes this decentralized control difficult. If the operational commander is unable to effectively communicate with his decentralized forces, how can he alter the sequencing of forces and actions, if battlespace circumstances change? For example, if a diplomatic solution is found that negates the need for military effort, or if new intelligence provides different insight about an enemy's regional capability, the operational commander must be able to redirect or resequence his forces. The current interoperability gap between US and coalition/allied communications systems, makes this redirection or resequencing difficult.

If the US is determined to be a team player, as part of an international military coalition or alliance, then we need to make every effort to ensure that we can communicate and coordinate with the other members of our team. The current

inoperability of communication systems and the new implementation of more sophisticated US systems, makes the functioning of this team less effective and the communication between its members more difficult.

US Exacerbations

> *"...our vision is to provide an infosphere around each warfighter with the information, communications, command and control, and decision making for every aspect of the battlefield..."* - *LtGen Carl O'Berry, former USAF/SC*[13]

This is an important quote since Gen O'Berry was talking in a broad/joint sense about all warfighters, regardless of whether they were soldiers, sailors or airmen. Although this vision sounds very positive and the commitment to the warfighter is very supportive, this ability actually exacerbates the problem for the operational commander. For although this gives US troops the means to be an interactive part of the total battlefield, it actually isolates them from the coalition warriors fighting along side them. Whether this involves "big picture" decision making, the alteration of battlespace synchronizing and sequencing, or the meaningful use of these forces in achieving an objective, it means that these allied/coalition warfighters have to be treated differently than US troops. To understand the US commitment to this vision--a vision shared by all US services--we need to look at current efforts.

In 1995, the US Department of Defense (DoD) spent $8.5 billion[14] on communications and computer systems for the four services. This included the amount spent on the operations and maintenance of current systems, the procurement of new systems, and the research and development of new enhancements. Using an inflationary planning factor of 3 percent and assuming a sustained commitment of resources, this means that the DoD

will spend over $9.8 billion on communications-computer systems by the turn of the century. An astronomical figure that only a nation with the economy and GNP of the US can afford to spend on just one segment of the DoD infrastructure or on just one segment of the operational battlefield. Unfortunately, the other nations that are our allied/coalition team players simply don't have the resources to keep up with our expenditures.

While our coalition/allied partners continue to do all they can to maintain the capabilities of their current battlefield systems--all of which have been in existence for some time--the US is already developing and implementing the next generation of systems for their battlefield interaction and control. As discussed by US Army MGen Joe Rigby, "Digitization is the essential enabler that will facilitate the Army of the 21st Century's ability to win...and provide deciders, shooters, and supporters the information each needs to make the vital decisions necessary to overwhelm and overcome their adversary and win the overall campaign."[15] This is truly a great achievement and a necessary goal if our plans are to fight alone in the 21st Century. However, if we still intend to fight as part of a team, then we must realize and be mindful of the limited capabilities of our allies and coalition members. Without these capabilities and without the resources to spend on this next generation of communications systems, does this mean that multiple command and control networks will have to coexist on the battlefield in order for battlefield participants to interact? Although some of this currently exists due to differing kinds of communications (e.g., land lines, microwave links) and distances between communication points, the use of incompatible, generationally gapped communications systems competing for the same battlefield space not only invites coordination difficulties, but also

increases the vulnerability of the operational communications infrastructure as a whole. To use the old adage that "a chain is only as strong as its weakest link," the incompatibility and inoperability of operational battlefield systems may prove to be the weak link in our chain of forces.

If the problems with coordination and inoperability aren't enough, the US is also upping the battlefield ante. As discussed in Joint Vision 2010, "Information superiority will require both offensive and defensive information warfare...such as electronic intrusion into an information and control network to convince, confuse or deceive enemy military decision makers. There should be no misunderstanding that our effort to achieve and maintain information superiority will also invite resourceful enemy attacks on our information systems."[16] Although this is an area too important to overlook, especially since the intrusion into communications-computer systems already exists across the globe, we are willingly folding information warfare into the battlefield effort. This can be quite dangerous. As the quote mentions, we may be inviting adversaries to challenge us in this fourth dimension of the battlespace. Although we may be able to commit the resources to deal with this new challenge, our coalition and allied partners probably won't. As previously stated, many of them are still doing all they can to support their current, somewhat outdated communications systems for the rest of the battlefield. The introduction of this new kind of warfare is not only beyond their current capability, but also beyond their means to defend against it. As an additional vulnerability, this disparity between communications systems once again challenges the operational commander.

Quite simply, it increases the number of obstacles he must overcome in order to fight and win.

Coalition/Alliance Difficulties

> *"...there will be a time in the near future when we won't be able to participate with you...as it is now, we can hardly talk to you...soon you'll be too far ahead..."*
> *- Group Captain Stephen Chisnall, RAF*[17]

The US is not entirely at fault in this matter. Although the quote reiterates its seriousness, part of the problem is the inability of our allied/coalition members to keep pace. Like a man wading into the deep end of a pool, our coalition/allied partners may feel like they have finally gotten in over their heads. The commitment and effort of the US military and those of US private corporations, to maintain a technological edge over the rest of the world, has quite literally placed us in a new league. Unfortunately we've set a standard to which all other coalition/allied members must now measure up. This "measuring-up" is illustrated in a quote from an article about the scope of Britain's commitment to upgrading their communications systems, "The British Ministry of Defence (MoD) spends $200 million a year on all military telecommunications systems...but, running these systems is a significant drain on the defense budget...a recent report by the National Audit Office criticized shortfalls in the MoD's telecommunications expenditure."[18] As the last part of this quote suggests, Britain's level of effort is criticized because it cannot keep pace; especially since a great deal of this expenditure goes to maintaining the current, outdated systems we mentioned earlier. Although it may sound unfair, the US has to be able to count on coalition/allied partners for sharing some of the operational load. If Britain is unable to participate due to their inability to interoperate

with US communications systems, perhaps they need to reevaluate or reprioritize their expenditures and commitments. Although this stance sounds quite harsh, this stance is necessary for the operational commander. If a coalition or allied force signs up to do something, the operational commander must be able to count on the effectiveness and ability of that force to accomplish the mission objective.

Britain is not the only country with problems in committing resources to enhance military capabilities. As Jane's Defence Weekly reported, "...the French Government fulfilled predictions that 1996 would be the most fateful year for French defences since the early 1960s...money is playing a leading role in...cutbacks in the military."[19] Although this quote doesn't directly address the enhancement of communications systems or the inoperability of these systems with US systems, it was part of a greater article that discussed the inability of the French military to keep pace with the growing technological battlefield. Like Britain, France's inability to keep pace means that their share of any future coalition/allied military effort will be limited. Whether it involves a direct force-on-force military capability or the interoperability of communication systems to direct those forces, this means one less strength and one more reduced capability in the operational commander's battlefield arsenal. It also means one more area, objective, or aspect that will have to be addressed by US forces.

Solutions

"Learn to think continentally" - Alexander Hamilton

Until now, all of our discussion has had a foreboding sense...one of doom and gloom. However, as this opening quote suggests, we need to look at the "bigger picture" and

examine some the possibilities for making this situation better. That doesn't mean there is a solution, but perhaps a way of narrowing the interoperability gap. In this analysis, there are five possible courses of action. Although these actions are actually in the strategic sense, they directly impact the operational commander.

The first possible course of action is for the US to go it alone. In other words the US would no longer participate in military situations as part of an alliance or coalition. From our previous paragraphs, the benefits of this action are obvious--we only have to worry about what we bring to the fight and the operational commander is only concerned about the command, control and direction of US forces. Although there may still be some interservice coordination problems, all matters could be solved within the US organizational framework and chain of command. The problem of inoperability between our and other communications systems would also be gone, and we could proceed unabated with the development and deployment of highly technological, new generational systems. The only limit to what the US military could employ would be that dictated by the budget (a definite parameter, but one that currently has a lot of zeros after it). The greatest drawback to this course of action is the fact that it will never happen. The US is mindful of its superpower role and the fragility of its reputation on the world stage (as evidenced by international criticism during Vietnam). The US also knows that in order to maintain its worldwide vested interest, it must be a team player and a participant in future international actions, whether they're of diplomatic or military nature. Lastly, the US doesn't have the resources to go it alone. We may have had the resources in the cold war

days, but the effects of our downsizing mean that we will require the future support of other nations.

Another possible course of action is to provide coalition/alliance members with the necessary communications systems for them to keep pace. This means simply giving coalition and allied forces the necessary communications hardware and software to eliminate the gap in the interoperability of our systems. The benefits would be much the same as described in the paragraph above in that we would only have to solve the connectivity or coordination problems associated with our systems. The benefit to the operational commander is that he can now use familiar, supportable systems with which to command, control and direct his forces. Although it may take some time to train all the coalition/allied forces in the use of US systems, the training would be fairly standardized and could use existing US training principles. Unfortunately, there are two big drawbacks to this course of action. The first is expense. Although the US currently spends a great deal of money on communications systems, the amount required to supply these systems to all allied/coalition members would be staggering (it would also probably add another zero to the end of our national debt figure). The second drawback would be the surrendering of our technological edge. As previously stated, the US military and US private organizations expend a lot of effort to maintain this edge. The repercussions of giving it away would not only be felt on the operational battlefield, where an adversary may have access to it, but also in the global marketplace.

Another course of action, that is current underway, is to provide coalition/alliance members with screened information received from US communications systems. In fact,

this sharing of information could occur at all levels of operational command. As the Army Times reported, "All issues of sharing information with allies will be determined by US Admiral Leighton Smith, NATO commander in chief of Allied Forces Southern Europe."[20] As this quote suggests, an extreme example of this sharing was Admiral Smith's personal involvement in the screening of Bosnian information to allied forces. A benefit of this screening and sharing of information is that the operational commander can use his own US communications systems for the command, control and direction of forces. He is also able to control the type of information passed to his subordinate or to the coalition/allied commanders. In other words, he has centralized control of all activity, since all activities are being funneled through his US channels. Of course the greatest drawback to this course of action is the time consuming effort involved in the process. The process would create a bottleneck of information that could well be overwhelming. As Admiral Halsey realized during World War II's Leyte Gulf effort, information overload can introduce a new problem, blurring the coordination of forces and/or the operational objective.

A course of action that's currently underway is the attempt to standardize all future acquisitions so that new allied/coalition communications systems are immediately compatable with those of the US. This effort was recently reported in Jane's Defence Weekly, "In Nov 1995, seven NATO nations demonstrated a database-to-database system interconnection between their communications-computer systems. Their success was based on a predetermined and preset standard that all systems had to meet. This included predetermined protocols and physical links. The advantage of this is that users will be able

to exchange C2 information directly."[21] The benefit of this arrangement is that interoperability will be guaranteed. For the operational commander, it means that he will be able to perform his functions unabated. The drawback to this course of action, is the limiting of US efforts. This means that the development and implementation of new technology could not proceed until it was agreed upon by all coalition and allied members. Anyone who has been part of a committee knows how difficult this agreement could be. It also means the US would be limited by the resources other nations could commit to the effort (as mentioned earlier, these commitments are currently much less than that of the US). Lastly, our agreement to preset standards could be viewed as another means of surrendering of our technological edge. Although preset standards may ensure interoperability, they may also dull the edge of our battlefield command and control.

The last course of action is that of centralized planning with all members, but the use of coalition/alliance forces in only low-tech situations. This is somewhat related to our first course of action, that of the US going it alone. The difference with this approach is that the US is still a team player and is still dependent on other nations for operational support. In other words, the US is not going it alone, just accepting the lion's share of the operation. An example of this might be the use of US forces and command, control and communications systems to perform the more sophisticated part of an operation; e.g., nighttime bombing raids on Baghdad, while coalition/allied forces were involved in securing ports, airfields and roadways. Although these allied/coalition roles might be less sophisticated, they are nonetheless crucial to operational success. The greatest benefits of this course of action is that all team members are involved in the operation, but that the

inoperability of communications systems is reduced and regionally controllable. The greatest drawback to this course of action is that the US assumes not only the lion's share of the effort, but also the lion's share of the risk.

The important thing to learn from this section is that there are positive and negative aspects to any course of action. Although efforts are being made to narrow the interoperability gap, these efforts are currently insuffucient and greatly impact the US in direct and indirect costs. For the operational commander, that current cost could mean the difference between mission success and failure.

Conclusion

"The only limit to our realization of tomorrow will be our doubts of today. Let us move forth with strong and active faith." - *Franklin Delano Roosevelt*

We opened this paper with a quote from Benjamin Franklin that talked about remembering the "little stuff." The things that may not be as glamorous or as high profile as some other military elements, but things that are just as critical to the success of any military operation. The critical element we described was the inoperability between US and coalition/allied communications systems. Parameters were also defined as a means of determining its relevance and emphasizing its importance to the operational commander. Specifically, we tried to define and codify the interface between communications interoperability and the ability of the operational commander to exercise command, control and direction across the range of military operations.

The thesis and body of our paper highlighted the widening gap of this interoperability. A gap that is increasing with every newly developed and newly fielded US high-tech, sophisticated communications system. A gap and a problem that must be addressed

before it reduces the effectiveness of coalition and allied operational forces. Efforts are being made and courses of action explored, but for now they all have some serious drawbacks to the benefits attained. The seriousness of the problem, to all our allied nations, is captured in a quote from Signal magazine. In identifying the efforts of other nations it stated, "Representatives...from more than 30 other countries, are designing the framework for sharing high-technology advances...These countries want to ensure that benefits of the information age will reach all (their) nations, regardless of economic status."[22] As this quote suggests, we must continue to emphasize the need and criticality of communications systems interoperability for all "team" members.

To finish on an upbeat note, our last section closes out with a quote from the great motivator, Franklin Delano Roosevelt. He tells us that now is the time to commit ourselves to solving the problem. Given the right framework, outlook, and commitment of effort, we can overcome it.

"...commitment to a group effort. That's what makes a team work, a company work, a society work, a civilization work." - *Vince Lombardi*

Endnotes

[1] Quote reprinted from the opening of the JMO Department Glossary of Terms. See Milan Vego, "Glossary of Operational Terms," An Unpublished Paper, U.S. Naval War College, Newport, RI: August 1996.

[2] For more discussion on "interoperability" as it relates to communications systems, see the definition from: Joint Chiefs of Staff, Joint Pub 6-0: *Doctrine for Command, Control, Communications and Computer (C4) Systems Support to Joint Operations* (Washington DC: Government Printing Office, 30 May 1995), GL-6.

[3] As defined by Webster's Dictionary, see A Merriam & Webster, *Webster's New Collegiate Dictionary*, (Springfield, MA: G.&C. Merriam Company, 1977), 596.

[4] Vego, "Glossary of Operational Terms," 4.

[5] Merriam & Webster, *Webster's New Collegiate Dictionary*, 30.

[6] Joint Chiefs of Staff, Joint Pub 6-0, "Doctrine for C4 Systems, " GL-5.

[7] A comment of President Eisenhower's, soon after his first inauguration, in response to a question about US leadership and the role the US will play in international politics. See Charles Hurd, *A Treasury of Great American Quotations* (New York, NY: Hawthorne Books, Inc., 1964), 295.

[8] Based on the author's experience in the Bosnian (former Yugoslavian) area of operations in dealing with command and control communications systems. BGen Robert Glacel, USA, was the Chief of Programs and Requirements at SHAPE's Policy Division. See Joris Janssen Lok, "Drawing Together NATO's Databases," *Jane's Defence Weekly*, 3 January 1996, 22-23.

[9] For information on "synchronization" and its use by the joint/operational commander, see Joint Chiefs of Staff, Joint Pub 2-0: *Joint Doctrine for Intelligence Support to Operations* (Washington DC: Government Printing Office, 5 May 1995), GL-12.

[10] For more information on "synchronization" and its use by the US Army, see Headquarters Department of the Army, Field Manual 100-5: *Operations* (Washington DC: Government Printing Office, 14 June 1993), 6-13.

[11] Vego, "Glossary of Operational Terms," 24.

[12] As discussed and defined by the importance of reliable, interoperable communications systems to the US Marine Corps. See Capt William D. Harrop, USMC, "Implicit Communications: A Warfighting Imperative," *Marine Corps Gazette*, January 1996, 65-66.

[13] Briefed to attendees of the US Air Force Advanced Command, Control Communications and Computer Officer Training School in May 93 at Keesler Air Force Base, MS. LtGen Carl O'Berry was the US Air Force Deputy Chief of Staff for Command, Control, Communications and Computer systems and was responsible for all the planning, implementation and interoperability of these systems.

[14] Figure does not include wages of supporting manpower or proposed new military construction projects. For more information or a breakout by service component, see The Department of Defense Budget Extract, *The Budget of the United States Government* (Washington DC, Government Printing Office, 1994), 261-312.

[15] MGen Joe Rigby, USA, Headquarters Department of the Army, *Army Digitization Master Plan* (Washington DC: Government Printing Office, January 1996), 1.

[16] For more information on the emerging importance of information warfare, see Joint Chiefs of Staff: *Joint Vision 2010* (Washington DC), 16.

[17] Group Captain Stephen Chisnall, Royal Air Force, was one of the UK representatives at the Naval War College's Summer War Game in July 1996. He made this closing comment/summation to the war game's acting National Command Authority and its audience of war game participants.

[18] This article discusses the problems with British military communications systems. See David Miller, "Rationalizing Telecommunications the British DFTS," *International Defence Review*, January 1996, 35.

[19] The problem with defense spending and its impact on manpower and technology is addressed in this article. See Jac Lewis, " Privatisation and Professional Army Define French Downsizing," *Jane's Defence Weekly*, 31 July 1996, 17.

[20] See Pat Cooper, "Communications System Links Allies," *Army Times*, 26 February 1996, 26.

[21] Lok, "Drawing Together NATO's Databases," 24.

[22] For the importance of communications interoperability and the commitment of allied/coalition nations in meeting US standards, see Maryann Lawlor, "Countries Collaborate to Share Information-Age Benefits," Signal, October 1996, 61.

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